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PLASTEC REPORT 21

**SUBJECT INDEX, BIBLIOGRAPHY, AND CODE DESCRIPTION  
OF TECHNICAL CONFERENCE PAPERS ON PLASTICS:  
2 MARCH 1964--5 MARCH 1965**



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**PLASTICS TECHNICAL EVALUATION CENTER**

PICATINNY ARSENAL  
DOVER, NEW JERSEY

PLASTEC REPORT 21

**SUBJECT INDEX, BIBLIOGRAPHY, AND CODE DESCRIPTION  
OF TECHNICAL CONFERENCE PAPERS ON PLASTICS:  
2 MARCH 1964—5 MARCH 1965**

by  
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and  
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**JUNE 1965**

PLASTICS TECHNICAL EVALUATION CENTER  
PICATINNY ARSENAL, DOVER, NEW JERSEY

## ABSTRACT

The papers presented at technical conferences on plastic materials and related technology, within a one year period ending 5 March 1965 have been listed, indexed by subject, and compiled by material, type of technical data, and military application. Over 550 papers from 23 conferences have been covered. Included are a bibliography, author index, summary of new material developments, and a list of applications and programs sponsored by the Department of Defense and the National Aeronautics and Space Administration.

The conferences covered are - American Chemical Society: Division of Organic Coatings and Plastics Chemistry - American Institute of Aeronautics and Astronautics: 5th Annual Structures and Materials Conference - American Physical Society: Division of High Polymer Physics - British Plastics Federation: Fourth International Reinforced Plastics Conference - Electronic Packaging and Production Magazine: National Electronic Packaging and Production Conference - National Academy of Sciences - National Research Council: Electrical Insulation- 1964 Annual Report - Society of Aerospace Material and Process Engineers: Adhesives and Elastomers for Environmental Extremes, 7th National Symposium - Society of Plastics Engineers: 21st Annual Technical Conference; ABS Plastics (RETEC - Regional); Advances in Moldmaking and Mold Design (RETEC); Engineering with Thermoplastics (RETEC); Extrusion - Materials, Theory and Applications (RETEC); Plastics and Adhesives in the Space Age (RETEC); Plastics Foams (RETEC); Plastics in the Electrical Industry (RETEC); Plastic Pipe: Design, Fabrication and Markets (RETEC); Plastics Sandwich Laminates (RETEC); Reinforced Plastics in Transportation (RETEC); Rigid PVC - Creativity, Versatility, Progress (RETEC); Stability of Plastics (RETEC) - Society of the Plastics Industry: 20th Annual Technical Conference, Reinforced Plastics Division - Southern Research Institute: Symposium on Polypropylene Fibers - U. S. Army Electronics Laboratories, Ft. Monmouth: 13th Annual Symposium, Technical Progress in Communication Wires and Cables.

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## SECTION 1. INTRODUCTION AND DISCUSSION

This is the fifth annual report by the Plastics Technical Evaluation Center on those technical conferences which have worthwhile information and data on plastic materials, applications and related technology. 552 papers presented at 23 technical conferences over the year period ending March 5, 1965 are covered.

These reports are intended to permit the reader to determine quickly the following:

- What has been presented on a particular subject; for example - "ablation".
- The types of materials and data contained in each paper presented.
- All papers which contain information on a particular type of material; for example - "epoxy".
- All papers which contain a particular type of data; for example - "creep".
- All papers which discuss military uses of plastics; for example - "ammunition closing plug".
- All the papers presented by a specialist or authority in the field.
- The major technical conferences containing information on plastics, presented during one year.

During the past year numerous new materials were reported on. The number of new plastic materials introduced per year is increasing rather than decreasing. Some of the new materials reported on include:

- Polycycloamide. High molecular weight polyamides based on 1, 4 cyclohexylenedimethylene suberamide (ref. 39).
- Ionomer resins. A new family of thermoplastic resins which contain inter and intra ionic bonds in addition to the basic covalent bonds present in all high molecular weight polymers (ref. 40).
- Epoxy-acrylate resin. Used with or without styrene as the binder in the reinforced plastics field (ref. 51).
- Chlorostyrene. A cross linking agent in place of styrene for the reinforced plastics field using polyester resins (ref. 98).
- Polyimide. Applications of these high temperature materials are increasing for varnish, film, and fabricated parts. Market development quantities of "H Film" to be available in the first half of 1965 (ref. 242).
- Thermoplastics. The building industry is seeing a market increase in the use of thermoplastics. These developments are reviewed in reference 253.

- Styrene-maleic anhydride resins as binders in the reinforced plastics field (ref. 376).
- Electrically conducting polymers based on vinylpyridinium TCNQ<sup>-1</sup> (ref. 378).
- Interfacial anodic polymers from benzene in hydrogen fluoride (ref. 381).
- Resins from polyhexaallylmelamine and related polymers (ref. 389).
- Polyphenylene oxide. A new family of thermoplastics available from pilot plant in 1965. Paper presented at SPE ANTEC but was not included in preprint. Article in Modern Plastics, December 1964.
- Polyparaxylylene capacitors. This polymer is deposited from vapor directly on a metal substrate. Is example of a new plastic and a new polymerization technique. The capacitor announcements were made in 1964 (Union Carbide) and references on the polymer in 1965 (p. 73-83, Polymer Preprints, ACS, Div. Pol. Chem., Detroit, April 1965, Vol. 6, No. 1).

Department of Defense uses plastics in many applications and sponsors research in many areas of plastics technology. A listing of conference papers which contain information on specific military items (ammunition, armor, boats, boosters, fuel tanks, etc. ) and programs sponsored by the Department of Defense or the National Aeronautics and Space Administration is presented in Section 7.

This report includes only those conferences having information on plastics where preprints or proceedings were issued and available to PLASTEC, and which were concerned with or potentially useful to the Department of Defense. Some conferences have thus been omitted. If an organization feels that the proceedings of its technical conferences should be considered for inclusion in the next conference review report (covering March 1965 to March 1966), it is suggested that a copy of the proceedings be sent to PLASTEC. Comments and/or suggestions on this report are invited.

**THIS CENTER DOES NOT DISTRIBUTE COPIES OF CONFERENCE PROCEEDINGS. THE PROPER SOURCES FOR SUCH DOCUMENTS ARE IDENTIFIED IN THE BIBLIOGRAPHY (SECTION 9), AT THE HEADING OF EACH MEETING REPORTED.**

## SECTION 2. ORGANIZATION OF REPORT

This report has seven major divisions: code sheet; subject index of conference papers; a compiled list of reference numbers of conference papers which contain information on a particular type of plastic material; a compiled list of reference numbers of conference papers which contain a particular type of data; a subject index of military applications involving plastics; a bibliography of conference papers; and an author index. Each division is now discussed briefly, to simplify the use of this report.

### Code Sheet Assembly (Section 3, Section 8)

A numerical code system is used to describe the contents of each paper; that is, to tell the reader which plastic material is discussed and what type of data are presented. The code sheet assembly consists of three sections:

- The CODE SHEET proper, with the numerical listing of the code numbers and the meaning of each; for example - 1.8 signifies "Epoxy" (material); or 2.1 signifies "Acoustic" (type of data).
- The breakdown of plastic material sub-groups appearing in the CODE SHEET; for example - 1.2 signifies "Acrylic", which includes "Polymethylmethacrylate" and "Methylmethacrylate - styrene copolymer".
- An alphabetical listing of polymers, for example - "ABS" is represented by code number 1.20; "Acetal" by 1.1; "Acrylic" by 1.2.

Two code sheets are provided for simplification of handling. One (Section 3) is in the forepart of the report, and the other (Section 8) is before the bibliography.

### Subject Index (Section 4)

The SUBJECT INDEX is presented in two columns: "Subject", and "Reference Number".

The principal subjects discussed in the various papers are listed alphabetically and margined. The variations upon the principal subject are sublisted, in alphabetical order also, and indented. For example, the reader may refer to the subject "Ablation". Thereunder note: evaluation tests (ref. 471); exit nozzle processing (ref. 157); mg. oxide fiber-phenolic (ref. 290); etc. It is suggested that the reader check all the variations under the subject of interest, as some of the principal subjects have over 50 variations.



The reference numbers were assigned arbitrarily to the conference papers by the authors. The numbers have no significance outside of the report. They appear in the left-hand column of the BIBLIOGRAPHY and in the right-hand column of the SUBJECT INDEX: and they are also used as the medium of reference in the various other lists.

#### Compiled Lists of Papers on Plastic Materials and on Data (Sections 5 and 6)

All the conference papers which contain information on a particular plastic material (for example, 1.8 -- "Epoxy") or which contain a particular type of data (for example, 2.27 -- "Creep") have been compiled into lists. There are: COMPILED LISTS OF PAPERS ON INDIVIDUAL PLASTIC MATERIALS (Section 5) and COMPILED LISTS OF PAPERS HAVING SPECIFIC TYPE OF DATA ON THE PROPERTIES OF PLASTICS (Section 6). To find all the references having some type of information on epoxy materials, one would check code 1.8 in Section 5. This group is more extensive than the "epoxy" list in the SUBJECT INDEX. Only those references which contain a substantial amount of information on "epoxy" are included in the SUBJECT INDEX, whereas the list in Section 5 was designed to find all the references on a material. To locate all those references which contain a particular type of data, either tabular or graphical, one would check Section 6\*. For example, to find references containing weathering data on epoxy materials, one would search for the reference number which appear in both 1.8 of Section 5 ("epoxy") and 2.23 of Section 6 ("Weathering"). Reference numbers 70 and 389 are the only ones which appear in both 1.8 and 2.23, and therefore it can be assumed that these are the only papers in this report possibly containing weathering data on epoxy materials. In this usage, Section 5 and Section 6 are a coordinate indexing system. To facilitate usage of this system, the reference numbers are arranged in numerical order in all the subdivisions (35 subdivisions in Section 5 and 43 in Section 6).

#### Subject Index of Papers on Applications and/or Investigations Sponsored by Department of Defense and the National Aeronautics and Space Administration (Section 7)

The conference papers were searched in order to locate those which contain information on specific military uses of plastics and military projects on plastics. Reference numbers of those papers were then compiled and indexed alphabetically and the results are presented in Section 7. For example, the reference number 245 under

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\* However, if a paper discussed a property or test method, etc., without including data, it would not be listed in this group.

the subject, ammunition, has information on plastics in military ammunition and can be located in the BIBLIOGRAPHY (Section 9). There are many papers on military sponsored projects which are not included in this listing because the authors did not acknowledge this.

#### Bibliography (Section 9)

The BIBLIOGRAPHY lists the papers presented at the 23 conferences covered in this report. Complete identification of the individual conference precedes the citations of the papers which were presented therein, including advice as to how to procure the preprint. The citations include: the title of the presentation, its author(s), the company affiliation, the section of the preprint or proceedings in which the paper appears, the number of pages comprising the paper and code description. The code descriptions tell the reader if the paper has information on materials and (if so) on which particular materials; and if the paper contains data (tabulated or graphic information) and (if so) on which types of data. For example, Reference No. 1, Thermal Processing Stability of Vinyl Chloride Plastics, has the code numbers (1.34, 2.38, 2.40). The following may be assumed from the code numbers used to describe that reference: that the paper has information on polyvinyl chloride (1.34) and that included are the following types of data: Rheological (2.38), and Thermal other than ablation and flammability (2.40). In this usage, the code is intended to tell the reader what is in the particular reference. The conferences reported are:

Ref No.	Sponsor	Date	Conference or Symposium
1 - 90	SPE	Mar 1965	21st Annual Technical Conference, Society of Plastics Engineers
91 - 191	SPI	Feb 1965	20th Anniversary Technical Conference, Reinforced Plastics Division, Society of Plastics Industry, Inc.
192 - 215	U.S. Army Electronic Lab's. Ft. Monmouth	Dec 1964	13th Annual Symposium, Technical Progress in Communication Wires and Cables
216 - 223	Electronic Packaging and Production Magazine	Jun 1964	National Electronic Packaging and Production Conference
224 - 243	SPE	Jun 1964	Stability of Plastics (RETEC)
244 - 253	SPE	Apr 1964	Engineering with Thermoplastics (RETEC)
254 - 268	SPE	Mar 1964	Extrusion Materials, Theory and Applications (RETEC)
269 - 278	SPE	Apr 1964	Advances in Moldmaking and Mold Design (RETEC)
279 - 284	SPE	May 1964	Plastics Sandwich Laminates (RETEC)
285 - 298	SPE	May 1964	Plastics and Adhesives in the Space Age (RETEC)
299 - 315	SPE	Apr 1964	ABS Plastics (RETEC)
315 - 324	SPE	Oct 1964	Rigid PVC - Creativity, Versatility, Progress (RETEC)
325 - 337	SPE	Nov 1964	Plastic Pipe: Design, Fabrication and Markets (RETEC)
338 - 346	SPE	Oct 1964	Reinforced Plastics in Transportation (RETEC)
347 - 359	SPE	May 1964	Plastics in the Electrical Industry (RETEC)
360 - 368	Southern Research Ins.	Sep 1964	Symposium on Polypropylene Fibers
369 - 418	ACS	Aug-Sept 1964	American Chemical Society, Division of Organic Coatings and Plastics Chemistry
419 - 454	NAS - NRC	Oct 1964	Electrical Insulation - 1964 Annual Report

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Ref No.	Sponsor	Date	Conference or Symposium
455 - 485	SAMPE	May 1964	Adhesives and Elastomers for Environmental Extremes, 7th National Symposium
486 - 517	British Plastics Federation	Nov 1964	Fourth International Reinforced Plastics Conference
518 - 537	American Physical Society	Mar 1964	High-Polymers Physics, The American Physical Society, Division of High Polymer Physics
538 - 543	AIAA	Apr 1964	5th Annual Structures and Materials Conference, American Institute of Aeronautics and Astronautics
544 - 552	SPE	Nov 1964	Plastics Foams (RETEC)

#### Author Index (Section 10)

An AUTHOR INDEX has been included to permit the easy location of the work of a particular author. It is recognized that a person may be known for his authority in a particular field and the reader may wish to check on his output; or that the reader may wish to follow through on a rumor that a particular specialist had given a paper some-where. To help in such cases, this index has been compiled. Reference is again, by number, to the particular paper(s) in the BIBLIOGRAPHY.

### SECTION 3. CODE SHEET ASSEMBLY

#### 1. PLASTIC/POLYMERIC MATERIAL TYPES

(See "Breakdown..." adjacent)

- 1.1 Acetal
- 1.2 Acrylic group
- 1.3 Allylics
- 1.4 Amino
- 1.5 Butadiene-styrene
- 1.6 Cellulosics
- 1.7 Elastomer (other than listed herein)
- 1.8 Epoxy
- 1.9 Fluorocarbon
- 1.10 Inorganic (no carbon in polymer backbone; see 1.33 for silicone)
- 1.10A Ionomer
- 1.11 Phenolic
- 1.12 Phenyl-silane, Phenylene oxide
- 1.12A Phenyl oxide
- 1.13 Poly (amide)
- 1.14 Poly (carbonate)
- 1.15 Poly (ester); alkyd
- 1.16 Poly (ether)
- 1.17 Poly (ethylene)
- 1.17A Ethylene-copolymers
- 1.18 Poly (imide)
- 1.19 Poly (propylene)
- 1.20 Poly (styrene) group
- 1.21 Poly (sulfide)
- 1.22 Poly (urethane)
- 1.23-1.32 Semiorganic polymers (Carbon+ element listed below in backbone)
- 1.23 Aluminum in backbone
- 1.24 Arsenic in backbone
- 1.25 Boron in backbone
- 1.26 Chromium in backbone
- 1.27 Nitrogen in backbone (excluding polyamide and polyurethane)
- 1.28 Phosphorus in backbone
- 1.29 Sulphur in backbone
- 1.30 Tin in backbone
- 1.31 Titanium in backbone
- 1.32 Other element in backbone
- 1.33 Silicone (see 1.12 for phenyl silane)
- 1.34 Vinyls
- 1.35 Unidentified

#### 2. TABULATED OR GRAPHICAL DATA ON THESE PROPERTIES AND/OR UNDER THE ENVIRONMENT LISTED HEREIN

- 2.1 Acoustic
- 2.2 Adhesive
- 2.3 Aging (except 2.16, 2.23)
- 2.4 Effect of chemicals (except 2.5-2.12)
- 2.5 Compatibility
- 2.6 Effects of water or moisture
- 2.7 Molecular/polymer structure
- 2.8 Permeability, vapor transmission
- 2.10 Stress cracking, crazing
- 2.11 Toxicity
- 2.12 Weight loss
- 2.13-2.16 Electrical properties
- 2.13 Excepting 2.14-2.16
- 2.14 Arc, corona, tracking, treeing
- 2.15 Electric strength
- 2.16 Thermal aging of elec comp
- 2.17-2.23 Properties under these environments
- 2.17 Environments except 2.18-2.23
- 2.18 Irradiation
- 2.19 Vacuum
- 2.20-2.23 Properties at these conditions
- 2.20 Prop. at temp below -100°F
- 2.21 Prop. at temp (-100°F to +32°F)
- 2.21A Prop. at temp (+150°F to 500°F)
- 2.22 Prop. at temp over 500°F
- 2.23 Weathering
- 2.24-2.36 Mechanical properties
- 2.24 Other than 2.25-2.36
- 2.25 Bearing
- 2.26 Cushioning; damping
- 2.27 Creep
- 2.28 Compression
- 2.29 Dynamic loading
- 2.30 Fatigue
- 2.31 At high load rate
- 2.32 Hoop tension; burst; buckling
- 2.33 Modulus; compliance
- 2.34 Shear
- 2.35 Stress relaxation
- 2.36 Stress-strain curve
- 2.36A Dimensional stability
- 2.37 Optical incl infrared spectra
- 2.38 Rheological
- 2.39 Surface
- 2.40-2.42 Thermal
- 2.40 Thermal other than 2.41-2.42
- 2.41 Ablation
- 2.42 Flammability
- 2.43 Thermodynamic

## Breakdown of Plastic Material Sub-groups in Code Sheet

Some materials listed under 1 in code sheet cover several groups - i.e., 1.11 Phenolic covers Phenol-formaldehyde and Phenol-furfural. Following are the material subgroups used in this report.

1.2	Acrylic Polymethyl methacrylate Methyl methacrylate-styrene copolymer	1.23-1.32	Semiorganic polymer If a polymer containing two or more such elements is listed - i.e., polybenzborimidazolines, then it is listed in each group, i.e., 1.25, 1.27.
1.3	Allylic Diallyl phthalate Other diallyl materials	1.25	Boron in polymer backbone Polybenzborimidazolines Polyborophane
1.4	Amino Urea formaldehyde Melamine formaldehyde	1.27	Nitrogen in polymer backbone (Aliphatic polyamide, i.e., nylon and the urethanes are not listed in this group.) Polybenzimidazole Polybenzborimidazolines Polyoxadiazole Polyhydrazide Polyphenylene triazole Polythiazole
1.6	Cellulosic Ethyl cellulose Cellulose acetate Cellulose propionate Cellulose acetate butyrate Cellulose nitrate	1.28	Phosphorus in polymer backbone Polyborophane
1.8	Epoxy Epoxy casting and molding materials Epoxy novolac Epoxy polyolefin Epoxidized polybutadiene Phenoxy	1.29	Sulphur in polymer backbone (excluding polysulfides) Polythiazole Polyphenylene sulfide Polytriazinylene sulfide
1.9	Fluorocarbon Polytetrafluoroethylene Fluorinated ethylene propylene polymers Polychlorotrifluoroethylene Polyvinylidene fluoride	1.34	Vinyls, vinyl chloride Vinyl acetate Vinyl alcohol Vinyl butyral Vinyl chloride Vinyl chloride-acetate Vinylidene chloride Vinyl formal Polyvinylidene chloride
1.11	Phenolic Phenol-formaldehyde Phenol-furfural		
1.20	Polystyrene Group (see also 1.5) Polystyrene Styrene-acrylonitrile copolymer Acrylonitrile-butadiene-styrene terpolymers and blends		

Both the main group - i.e., Phenolic - and subgroup - i.e., Phenolformaldehyde and Phenol-furfural - are listed by their chemical nomenclature. In order to determine the chemical group of a particular commercial plastic material - i.e., Teflon, or the trade name of particular materials, it is suggested that the reader refer to the published lists of plastic material trade names. One source is the Modern Plastics Encyclopedia.\*

\* Modern Plastics Encyclopedia, published yearly.  
Modern Plastics Magazine, New York City, Breskin Publications, Bristol, Conn.

### Alphabetical List of Polymer Sub-Groups

ABS . . . . .	1.20	Phenyl-silane . . . . .	1.12
Acetal . . . . .	1.1	Phenylene oxide . . . . .	1.12A
Acrylic . . . . .	1.2	Poly (allomer). . . . .	1.17A
Acrylonitrile-butadiene-		Poly (amide) . . . . .	1.13
styrene terpolymers & blends .	1.20	Poly (benzborimidazoline) . . .	1.25; 1.27
Alkyd . . . . .	1.15	Poly (benzimidazole) . . . . .	1.18; 1.27
Allylic . . . . .	1.3	Poly (borophane) . . . . .	1.25; 1.28
Amino . . . . .	1.4	Poly (carbonate) . . . . .	1.14
Butadiene-styrene . . . . .	1.5	Poly (chlorotrifluoroethylene) .	1.9
Cellulose acetate . . . . .	1.6	Poly (ester) . . . . .	1.15
Cellulose acetate butyrate. . .	1.6	Poly (ether) . . . . .	1.16
Cellulose propionate. . . . .	1.6	Poly (ethylene) . . . . .	1.17
Cellulose nitrate . . . . .	1.6	Poly (hydrazide). . . . .	1.27
Cellulosic . . . . .	1.6	Poly (imide) . . . . .	1.18
Diallyl phthalate . . . . .	1.3	Poly (methyl methacrylate) . . .	1.2
Elastomer (other than listed		Poly (oxadiazole) . . . . .	1.27
herein) . . . . .	1.7	Poly (oxymethylene). . . . .	1.1
Epoxidized		Poly (phenylene oxide) . . . . .	1.12A
polybutadiene . . . . .	1.8	Poly (phenylene sulfide). . . . .	1.29
Epoxy . . . . .	1.8	Poly (phenylene triazole) . . . .	1.27
Epoxy novolac . . . . .	1.8	Poly (propylene). . . . .	1.19
Epoxy polyolefin. . . . .	1.8	Poly (styrene). . . . .	1.20
Ethyl cellulose . . . . .	1.6	Poly (sulfide) . . . . .	1.21
Ethylene-ethyl acrylate		Poly (tetrafluoroethylene). . . .	1.9
copolymer . . . . .	1.17A	Poly (thiazole). . . . .	1.27; 1.29
Ethylene-propylene copolymer .	1.17A	Poly (triazinylene sulfide) . . .	1.29
Fluorinated ethylene propylene		Poly (urethane) . . . . .	1.22
polymers . . . . .	1.9	Poly (vinyl chloride) . . . . .	1.34
Fluorocarbon . . . . .	1.9	Poly (vinyl ether) . . . . .	1.16
FEP fluorocarbon . . . . .	1.9	Poly (vinylidene chloride). . . . .	1.34
Inorganic polymer (no carbon		Poly (vinylidene fluoride). . . .	1.9
in backbone: see 1.33 for		Semiorganic polymer . . . . .	1.23, 1.32
Silicone) . . . . .	1.10	Silicone . . . . .	1.33
Ionomer . . . . .	1.10A	Styrene-acrylonitrile copolymer	1.20
Melamine formaldehyde . . . . .	1.4	Urea formaldehyde . . . . .	1.4
Methyl methacrylate-styrene		Urethane. . . . .	1.22
copolymer . . . . .	1.2	Vinyl . . . . .	1.34
Nylon . . . . .	1.13	Vinyl acetate . . . . .	1.34
Phenolic . . . . .	1.11	Vinyl alcohol . . . . .	1.34
Phenol-formaldehyde . . . . .	1.11	Vinyl butyral . . . . .	1.34
Phenol-furfural . . . . .	1.11	Vinyl chloride . . . . .	1.34
Phenoxide . . . . .	1.12A	Vinyl chloride-acetate . . . . .	1.34
Phenoxy . . . . .	1.8	Vinyl formal . . . . .	1.34
Phenyl oxide . . . . .	1.12A	Vinylidene chloride . . . . .	1.34

# SECTION 4. SUBJECT INDEX

<u>Subject</u>	<u>Ref. No.</u>	<u>Subject</u>	<u>Ref. No.</u>
Ablation (see also Reentry)		Gels for medical use -----	399
Evaluation tests -----	471	Processing reinf. acrylics ----	494
Exit nozzle processing-----	157		
Mg. oxide fiber-phenolic ----	290	Adhesion (See Also 2.2 Section 6)	
Protection shells for reentry		Epoxy molding to tinned copper	
vehicles -----	542	wires -----	71
Reflective metal flakes -----	180	Reentry heat shields -----	289
Silicones, aerospace appl. ----	470	Strength tests of foam-skin	
Thermal shield bonding -----	289	comp. -----	282
Abrasion		Adhesives	
Mar resistance -----	392	Aromatic polymers to	
		metals -----	459
ABS (see also 1.20 Section 5)		Bonding diaphragms to al	
Applications in appliances ----	299	cylinders -----	178
Automotive instrument panels--	311	Conductive bonds -----	203
Blow molding -----	305	Conductive, flexible at low	
Color matching instrumentation	307	temp. -----	457
Decorations -----	309	Cryogenic applications -----	461
Extrusion equip. & technology -	306	Cryogenic to +1000° F use ----	465
Extrusion surface quality-----	8	Cryogenic structural appl. ----	294
Finishes, automotive parts ----	314	Dianhydrides in epoxy form ---	456
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\*Includes many subdivisions and is used here only when the subdivisions are not adequate.

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## SECTION 5. COMPILED LISTS OF PAPERS ON INDIVIDUAL PLASTIC MATERIALS

(By Reference Number)

NOTE: Each paper listed has information on the particular material. For additional information on particular materials, see: CODE SHEET assembly, "Breakdown of Plastic Material Sub-Groups in Code Sheet".

### Code

- 1.1      Acetal  
33, 41, 122, 249, 250, 252, 326, 347, 374, 455, 496, 519
  
- 1.2      Acrylic Group  
26, 29, 35, 51, 59, 75, 77, 80, 99, 108, 111, 122, 158, 178, 189, 224,  
230, 236, 250, 253, 266, 344, 347, 349, 365, 368, 396, 398, 399, 401,  
403, 404, 405, 418, 432, 452, 482, 491, 494, 496, 517, 525, 530
  
- 1.3      Allylics  
25, 109, 145, 347, 348, 350, 353, 403, 440, 441
  
- 1.4      Amino  
92, 216, 287, 347, 348, 349, 354, 376, 403, 404
  
- 1.5      Butadiene - styrene  
(None)
  
- 1.6      Cellulosics  
29, 35, 74, 178, 189, 224, 236, 239, 250, 330, 332, 365, 368, 398, 403,  
452, 462, 528, 531
  
- 1.7      Elastomer (other than listed herein)  
197, 199, 210, 226, 231, 233, 235, 253, 281, 332, 366, 367, 375, 398,  
403, 404, 455, 458, 472, 474, 478, 482, 484, 518, 524, 529, 536, 538,  
545
  
- 1.8      Epoxy  
25, 27, 28, 42, 45, 51, 54, 69, 70, 71, 72, 73, 86, 87, 91, 92, 94, 95,  
99, 105, 108, 118, 119, 122, 123, 134, 135, 136, 138, 139, 145, 148,  
149, 150, 151, 152, 154, 155, 168, 169, 177, 190, 216, 217, 218, 219,  
220, 221, 223, 224, 232, 281, 286, 287, 288, 289, 291, 292, 293, 294,  
295, 296, 297, 298, 328, 340, 344, 345, 348, 349, 350, 354, 355, 357,  
358, 359, 372, 376, 388, 389, 404, 405, 406, 407, 408, 409, 410, 411,  
412, 413, 414, 415, 416, 417, 418, 441, 442, 443, 444, 445, 451, 455,  
456, 457, 458, 461, 462, 463, 464, 465, 469, 474, 477, 481, 482, 485,  
488, 494, 498, 499, 500, 506, 512, 515, 517, 538, 542
  
- 1.9      Fluorocarbon  
38, 81, 178, 189, 191, 197, 212, 213, 214, 216, 236, 344, 349, 350,  
367, 370, 396, 398, 451, 467, 469, 470, 476, 478, 480, 483, 484, 517

Code

- 1.10 Inorganic  
(None)
- 1.10A Ionomer  
174
- 1.11 Phenolic  
10, 25, 44, 52, 53, 54, 92, 107, 109, 118, 124, 151, 175, 177, 224, 227,  
232, 285, 286, 287, 288, 289, 290, 291, 292, 295, 338, 345, 347, 348,  
349, 351, 352, 353, 354, 373, 376, 389, 391, 405, 415, 455, 458, 461,  
462, 463, 464, 465, 481, 496, 498, 499, 502, 507, 509, 517, 542
- 1.12 Phenyl - silane  
151, 455, 464, 465
- 1.12A Phenyl oxide  
(None)
- 1.13 Poly(amide)  
6, 26, 39, 41, 189, 191, 197, 212, 224, 230, 236, 241, 244, 250, 288,  
289, 291, 293, 294, 295, 365, 368, 398, 399, 401, 405, 452, 455, 459,  
460, 463, 465, 467, 469, 474, 477, 496, 517, 521, 525, 542
- 1.14 Polycarbonate  
14, 26, 35, 41, 74, 122, 189, 205, 239, 246, 252, 266, 289, 347, 349,  
405, 496
- 1.15 Polyester; Alkyd  
24, 55, 83, 92, 96, 97, 98, 99, 100, 101, 102, 106, 111, 116, 146  
147, 158, 159, 160, 170, 177, 179, 189, 191, 193, 197, 204, 205, 206,  
216, 224, 239, 241, 285, 287, 291, 295, 327, 341, 343, 344, 345, 346,  
347, 348, 349, 352, 365, 371, 373, 389, 390, 392, 401, 404, 405, 414,  
417, 418, 441, 449, 451, 484, 485, 488, 489, 490, 491, 491a, 492, 494,  
495, 496, 497, 498, 499, 503, 505, 507, 509, 510, 511, 512, 516, 517,  
521, 541
- 1.16 Polyether  
247, 289, 295, 467
- 1.17 Polyethylene  
19, 20, 21, 22, 26, 49, 56, 57, 58, 59, 60, 74, 75, 83, 84, 85, 90, 189,  
191, 193, 195, 196, 197, 200, 202, 205, 207, 209, 211, 214, 215A, 227,  
228, 233, 236, 239, 241, 247, 250, 253, 254, 256, 258, 262, 264, 266,  
288, 316, 330, 339, 344, 347, 349, 350, 360, 366, 368, 369, 370, 374, 386,  
396, 398, 399, 401, 403, 423, 424, 425, 449, 451, 452, 486, 496, 519,  
520, 525, 526, 527, 532, 533, 534, 535, 549, 550, 551
- 1.17A Ethylene - Propylene Copolymer  
65, 191, 202, 203, 261, 522, 523

Code

- 1.18 Polyimide  
54, 120, 122, 151, 177, 188, 213, 214, 216, 242, 243, 244, 292, 295, 296,  
344, 345, 350, 356, 455, 459, 465, 517
- 1.19 Polypropylene  
19, 20, 65, 66, 67, 68, 196, 204, 205, 206, 227, 233, 237, 238, 239, 247,  
250, 253, 266, 347, 349, 360, 361, 363, 364, 365, 366, 367, 368, 398, 425,  
452, 467, 496, 549
- 1.20 Polystyrene Group  
8, 19, 26, 29, 35, 74, 78, 81, 111, 122, 158, 189, 191, 214, 227, 230,  
236, 239, 245, 250, 252, 253, 266, 299, 300, 301, 302, 303, 304, 305,  
306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 330, 331, 341, 347,  
367, 376, 398, 400, 405, 418, 452, 496, 522, 523, 541, 543
- 1.21 Polysulfide  
235, 289, 291, 344, 387, 405, 457, 472, 474, 477, 484
- 1.22 Polyurethane  
55, 78, 79, 90, 179, 197, 216, 222, 224, 240, 282, 284, 288, 289, 294,  
295, 338, 344, 350, 382, 383, 401, 403, 451, 455, 457, 458, 461, 465,  
467, 472, 474, 477, 481, 482, 484, 502, 517, 539, 541, 543, 544, 546,  
549
- 1.23 Semiorganic - Aluminum in backbone  
(None)
- 1.24 Semiorganic - Arsenic in backbone  
(None)
- 1.25 Semiorganic - Boron in backbone  
455
- 1.26 Semiorganic - Chromium in backbone  
(None)
- 1.27 Semiorganic - Nitrogen in backbone (Excluding polyamide and polyurethane)  
224, 225, 241, 295, 455
- 1.28 Semiorganic - Phosphorus in backbone  
455
- 1.29 Semiorganic - Sulphur in backbone  
225, 241, 455
- 1.30 Semiorganic - Tin in backbone  
(None)
- 1.31 Semiorganic - Titanium in backbone  
(None)



Code

- 1.32 Semiorganic - Other elements in backbone  
455
- 1.33 Silicone (see 1.12 for Phenyl Silane)  
199, 215, 216, 285, 287, 291, 347, 348, 349, 389, 394, 396, 398, 401,  
405, 451, 455, 457, 463, 467, 468, 469, 470, 471, 472, 473, 475, 477,  
480, 482, 484, 498, 517, 537
- 1.34 Vinyls  
1, 2, 3, 4, 5, 14, 15, 16, 17, 18, 21, 22, 26, 35, 36, 46, 47, 48, 49,  
61, 81, 89, 122, 134, 193, 212, 214, 224, 233, 234, 236, 239, 248, 250,  
253, 255, 259, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 330,  
334, 347, 366, 367, 368, 374, 398, 401, 403, 404, 405, 451, 452, 462,  
465, 486, 496, 503, 506, 517, 530, 534, 548, 549, 552
- 1.35 Unidentified  
157, 162, 212

## SECTION 6. COMPILED LISTS OF PAPERS HAVING SPECIFIC TYPE OF DATA

### ON THE PROPERTIES OF PLASTICS

(By Reference Number)

NOTE: The papers listed here are limited to those containing data. If the paper discussed a property without inclusion of data, it would not be listed herein.

#### Code

- 2.1      Acoustics data  
482, 514
  
- 2.2      Adhesive  
6, 46, 71, 120, 211, 213, 315, 376, 382, 404, 455, 456, 457, 458, 459,  
461, 462, 463, 464, 465, 466, 475, 477
  
- 2.3      Aging (Except 2.16, 2.23)  
50, 53, 89, 146, 151, 154, 215, 240, 242, 243, 383, 389, 455, 458, 465,  
475, 476
  
- 2.4      Effect of Chemicals (Except 2.5 - 2.12)  
5, 49, 51, 67, 100, 215, 237, 241, 248, 299, 324, 325, 326, 367, 370,  
398, 410
  
- 2.5      Compatibility  
90, 99, 162, 202, 213, 244, 382
  
- 2.6      Effects of Water or Moisture  
4, 33, 39, 41, 49, 147, 154, 159, 162, 170, 199, 215A, 220, 240, 241,  
242, 244, 246, 248, 249, 322, 325, 370, 382, 383, 389, 398, 399, 401,  
415, 452, 488, 498, 509, 512, 531
  
- 2.7      Molecular/polymer Structure  
11, 39, 54, 60, 65, 68, 70, 73, 87, 94, 105, 123, 138, 147, 148, 149,  
168, 214, 224, 225, 232, 233, 234, 241, 242, 243, 254, 365, 366, 388, 389,  
394, 406, 407, 410, 412, 455, 467, 491
  
- 2.8      Permeability; Vapor Transmission  
6, 40, 78, 84, 86, 90, 200, 204, 241, 397, 398, 473, 477, 526
  
- 2.10     Stress Cracking  
75, 94, 202, 207, 247, 266, 301, 326, 370, 505
  
- 2.11     Toxicity  
69

Code

- 2.12 Weight Loss  
49, 51, 73, 89, 149, 161, 212, 235, 237, 242, 243, 244, 340, 367, 381, 382, 387, 388, 389, 456, 459, 464, 469, 492, 538
- 2.13 Electrical Properties (Excepting 2.14 - 2.16)  
26, 39, 40, 49, 69, 70, 79, 97, 100, 107, 136, 145, 148, 149, 195, 202, 203, 204, 210, 212, 213, 214, 215, 215A, 220, 242, 243, 340, 371, 372, 373, 374, 375, 376, 378, 381, 382, 386, 389, 394, 411, 424, 425, 426, 427, 444, 445, 457, 459, 468, 482, 512, 531, 539
- 2.14 Arc, Corona, Tracking, Treeing  
40, 107, 111, 244, 370, 376, 449
- 2.15 Electric Strength  
49, 51, 69, 70, 100, 107, 116, 136, 154, 202, 204, 210, 212, 213, 214, 215A, 242, 243, 376, 394, 440, 441, 442, 443, 468
- 2.16 Thermal Aging of Electronic Components  
70, 212, 373, 382
- 2.17 Environmental Effects on Properties (Except 2.6, 2.18 - 2.23)  
(None)
- 2.18 Effects of Radiation  
119, 214, 235, 241, 371, 387, 398, 424, 425, 451, 469, 509, 534, 539
- 2.19 Effects of Vacuum  
469
- 2.20 Data at Below (-) 100<sup>0</sup> F  
125, 424, 455, 460, 461, 463, 465, 467, 481, 519, 530
- 2.21 Data at (-) 100<sup>0</sup> F to 32<sup>0</sup> F  
424
- 2.21A Data at +150<sup>0</sup> F to 500<sup>0</sup> F  
10, 51, 54, 74, 148, 237, 247, 300, 361, 367, 372, 388, 389, 399, 408, 413, 415, 418, 423, 425, 441, 455, 456, 457, 458, 459, 461, 462, 463, 464, 465, 475, 481, 489, 491a, 492, 502, 503, 512, 519, 530, 533, 552
- 2.22 Data at Over 500<sup>0</sup> F  
54, 151, 242, 243, 366, 381, 389, 391, 415, 455, 459, 463, 465, 469, 473, 476, 481, 483, 492, 502, 517
- 2.23 Data on Weathering  
2, 3, 15, 18, 70, 81, 90, 158, 361, 389, 509
- 2.24 Mechanical Properties (Other than 2.25 - 2.36)  
5, 10, 11, 14, 15, 16, 17, 24, 27, 28, 33, 36, 38, 39, 40, 41, 43, 49, 50, 51, 52, 54, 58, 61, 65, 67, 70, 79, 81, 87, 90, 92, 94, 97, 98, 99, 100, 102, 103, 105, 106, 107, 109, 110, 116, 117, 118, 122, 125, 135, 136, 137, 138, 145, 147, 148, 149, 150, 151, 153, 155, 160, 162, 167,

Code

- 2.24 Mechanical Properties (Other than 2.25 - 2.36), continued  
174, 177, 178, 179, 187, 188, 189, 191, 197, 202, 204, 211, 212, 214, 215,  
223, 228, 230, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 252, 255,  
299, 304, 308, 322, 324, 325, 332, 340, 341, 346, 361, 363, 364, 368, 376,  
382, 394, 401, 403, 411, 412, 413, 415, 457, 458, 460, 461, 463, 467, 468,  
470, 475, 476, 477, 481, 488, 489, 494, 496, 498, 500, 503, 505, 507, 515,  
517, 540, 543
- 2.25 Bearing  
(None)
- 2.26 Cushioning; Damping  
125, 222, 223, 468
- 2.27 Creep  
10, 38, 41, 55, 75, 81, 246, 249, 522, 523, 525
- 2.28 Compression  
10, 25, 28, 38, 42, 45, 79, 87, 92, 93, 94, 95, 100, 106, 107, 110, 116,  
117, 125, 145, 148, 150, 162, 174, 181, 187, 189, 191, 205, 247, 383,  
405, 411, 412, 413, 415, 460, 468, 480, 481, 488, 494, 498, 502, 517
- 2.29 Dynamic Loading  
15, 43, 52, 55, 103, 249, 331, 542
- 2.30 Fatigue  
38, 41, 55, 91, 92, 103, 244, 248, 325, 461, 467, 525
- 2.31 High Load Rate  
24, 543
- 2.32 Hoop Tension; Burst; Buckling  
55, 66, 91, 112, 152, 153, 155, 156, 181, 190, 202, 241, 242, 248, 325,  
328, 330, 332, 411, 417, 500, 540
- 2.33 Modulus; Compliance  
10, 25, 26, 39, 41, 43, 45, 49, 50, 59, 61, 65, 67, 70, 75, 79, 80, 87,  
92, 94, 95, 98, 99, 102, 113, 116, 117, 122, 125, 136, 138, 139, 147,  
148, 149, 153, 155, 162, 179, 181, 187, 188, 202, 214, 228, 240, 241,  
242, 244, 245, 246, 247, 249, 304, 308, 322, 324, 325, 340, 341, 364,  
376, 405, 411, 412, 413, 417, 460, 476, 489, 496, 498, 499, 500, 503,  
507, 516, 517, 521, 525
- 2.34 Shear  
20, 22, 27, 28, 43, 51, 79, 82, 92, 93, 94, 95, 116, 117, 125, 136, 138,  
145, 149, 152, 154, 155, 169, 174, 175, 177, 181, 191, 202, 243, 257,  
411, 415, 416, 455, 456, 459, 461, 462, 463, 464, 465, 473, 481, 499,  
500, 517, 521
- 2.35 Stress Relaxation  
228

Code

- 2.36 Stress - Strain Curve  
38, 40, 49, 58, 59, 80, 87, 103, 112, 115, 118, 139, 155, 169, 215, 228,  
231, 241, 247, 249, 363, 413, 460, 503, 521, 522, 523
- 2.36A Dimensional Stability  
98, 136, 147, 162, 244, 245, 246, 247, 248, 255, 322, 324, 325, 340, 361, 368,  
405, 411, 413, 496, 517
- 2.37 Optical (Including Infra Red Spectra)  
18, 37, 53, 73, 75, 99, 104, 123, 124, 158, 213, 232, 235, 239, 307, 387,  
388, 406, 409, 509, 510, 511, 528, 529, 530, 533, 534
- 2.38 Rheological  
1, 8, 19, 20, 21, 22, 29, 33, 39, 46, 47, 48, 49, 50, 60, 65, 86, 99, 136,  
149, 155, 182, 188, 202, 207, 238, 252, 256, 257, 258, 259, 264, 302,  
320, 341, 361, 413, 550, 552
- 2.39 Surface  
8, 81, 102, 158, 167, 168, 190, 204, 211, 212, 213, 242, 342, 392, 416,  
511
- 2.40 Thermal Properties (Other than 2.41 - 2.42)  
1, 22, 25, 26, 33, 38, 41, 54, 55, 60, 61, 69, 70, 74, 78, 114, 125, 162,  
204, 205, 206, 210, 213, 214, 217, 218, 219, 220, 233, 234, 241, 242, 244,  
247, 248, 322, 325, 366, 367, 391, 461, 463, 476, 483, 541, 544
- 2.41 Ablation  
210, 391, 470, 471
- 2.42 Flammability  
90, 98, 127, 146, 147, 215, 241, 247, 248, 249, 325, 468, 496
- 2.43 Thermodynamic  
242, 376, 391, 408, 410, 418, 518

**SECTION 7. SUBJECT INDEX OF PAPERS ON APPLICATIONS AND/OR  
INVESTIGATIONS SPONSORED BY DEPARTMENT OF DEFENSE AND  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

	<u>Ref. No.</u>		<u>Ref. No.</u>
Ablation -----	157, 180, 290, 470, 471, 542	Nonr 3662 (01)	398, 399
		Nonr 3663 (01)	396, 397
ABMA - XPD 813	197	Nonr 4172 (00) (X)	94
		Nord 16640	231
Adhesives -----	178, 291, 292, 293, 294, 457	Now 60-0465d	295
		Cryogenic -----	288, 294, 478, 541
AF Bulletin No. 527-	294		
Aircraft -----	193	Electric strength -	440, 441, 442, 443, 444, 445
Ammunition -----	245	Encapsulation ----	221, 358
Antenna -----	177	Epoxy resin -----	94, 150, 412
Armor (ballistic)-	363	Expandable struc- ture -----	178, 179, 473
Biochemical degrad- ation -----	236	Fibers -----	290, 364
Boats and ships ---	177, 503	Filament winding --	42, 92, 93, 94, 95, 153, 155, 412
Booster, solid - 156", 260" ---	44	Fire (project)-----	285
Cable & wire (electrical) ---	193, 197, 199, 201, 214, 215	Fracture -----	231, 522, 523
Clothing -----	359A	Fuel tank -----	474, 476
Contract number		Glass fibers -----	137, 139
AF 33(615)-1610	151	Glass roving -----	27
AF 33(615)-11469	151	Heat shield -----	289
AF 33(616)-7775	178	High load rate ----	24
AF 33(657)-9623	137, 155	High temperature --	151, 292
AF 33(657)-9726	155	Hydrogel -----	399
AF 33(657)-11302	152	Implant -----	397
AF 33(657)-11303	153	Laminate -----	52, 151, 216
NAS 7-100	293	Minuteman -----	44
NAS 9- 1563	484		
N- 197- 1585(X)	150		
Nobs -86347	139		
Nobs -88351	91		
Nobs -90180	112		

	<u>Ref. No.</u>		<u>Ref. No.</u>
M <sub>g</sub> O fiber -----	290	Propellant -----	229, 480
Morphology -----	529	Radome -----	110
Motor case -----	156, 181, 540	Re-entry -----	44, 285, 289, 391
Multilayer laminate -	216	Rudder -----	177
Nitroso rubber -----	466	Saturn -----	288
Nose cone -----	44, 286	Sealants -----	178, 476, 477, 478, 480, 484
Nozzle -----	157, 176	Solar cell -----	291
Ophthalmology -----	396	Sterilization -----	398
Outgassing -----	538	Submarine -----	45, 91, 112
Photo degradation --	236	Titan -----	44
Polaris -----	44, 156, 540	Whiskers -----	295
Polymer research -	225, 231, 241, 399, 466, 529		

**SECTION 8. CODE SHEET ASSEMBLY**  
**Alphabetical List of Polymer Sub-Groups**

ABS .....	1.20	Poly(benzimidazole) .....	1.18; 1.27
Acetal .....	1.1	Poly(borophane) .....	1.25; 1.28
Acrylic .....	1.2	Poly(carbonate) .....	1.14
Acrylonitrile-butadiene-		Poly(chlorotrifluoroethylene) .....	1.9
styrene terpolymers & blends ..	1.20	Poly(ester) .....	1.15
Alkyd .....	1.15	Poly(ether) .....	1.16
Allylic .....	1.3	Poly(ethylene) .....	1.17
Amino .....	1.4	Poly(hydrazide) .....	1.27
Butadiene-styrene .....	1.5	Poly(imide) .....	1.18
Cellulose acetate .....	1.6	Poly(methyl methacry-	
Cellulose acetate butyrate .....	1.6	late) .....	1.2
Cellulose propionate .....	1.6	Poly(oxadiazole) .....	1.27
Cellulose nitrate .....	1.6	Poly(oxymethylene) ....	1.1
Cellulosic .....	1.6	Poly(phenylene oxide) ..	1.12A
Diallyl phthalate .....	1.3	Poly(phenylene sulfide) ..	1.29
Elastomer (other than listed		Poly(phenylene triazole) ..	1.27
herein) .....	1.7	Poly(propylene) .....	1.19
Epoxidized polybutadiene .....	1.8	Poly(styrene) .....	1.20
Epoxy .....	1.8	Poly(sulfide) .....	1.21
Epoxy novolac .....	1.8	Poly(tetrafluoroethylene) ..	1.9
Epoxy polyolefin .....	1.8	Poly(thiazole) .....	1.27; 1.29
Ethyl cellulose .....	1.6	Poly(triazinylene sulfide) ..	1.29
Ethylene-ethyl acrylate		Poly(urethane) .....	1.22
copolymer .....	1.17A	Poly(vinyl chloride) .....	1.34
Ethylene-propylene copolymer ..	1.17A	Poly(vinyl ether) .....	1.16
Fluorinated ethylene propylene		Poly(vinylidene fluoride) ..	1.9
polymers .....	1.9	Poly(vinylidene chloride) ..	1.34
Fluorocarbon .....	1.9	Semiorganic polymer ....	1.23, 1.32
FEP fluorocarbon .....	1.9	Silicone .....	1.33
Inorganic polymer (no carbon		Styrene-acrylonitrile	
in backbone: see 1.33 for		copolymer .....	1.20
Silicone) .....	1.10	Urea formaldehyde .....	1.4
Ionomer .....	1.10A	Urethane .....	1.22
Melamine formaldehyde .....	1.4	Vinyl .....	1.34
Methyl methacrylate-styrene		Vinyl acetate .....	1.34
copolymer .....	1.2	Vinyl alcohol .....	1.34
Nylon .....	1.13	Vinyl butyral .....	1.34
Phenolic .....	1.11	Vinyl chloride .....	1.34
Phenol-formaldehyde .....	1.11	Vinyl chloride-acetate ...	1.34
Phenol-furfural .....	1.11	Vinyl formal .....	1.34
Phenoxide .....	1.12A	Vinylidene chloride .....	1.34
Phenoxy .....	1.8		
Phenyl oxide .....	1.12A		
Phenyl-silane .....	1.12		
Phenylene oxide .....	1.12A		
Poly(allomer) .....	1.17A		
Poly(amide) .....	1.13		
Poly(benzborimidazoline) .....	1.25;		
	1.27		



# CODE SHEET

## 1. PLASTIC/POLYMERIC MATERIAL TYPES

(See "Breakdown..." adjacent)

- 1.1 Acetal
- 1.2 Acrylic group
- 1.3 Allylics
- 1.4 Amino
- 1.5 Butadiene-styrene
- 1.6 Cellulosics
- 1.7 Elastomer (other than listed herein)
- 1.8 Epoxy
- 1.9 Fluorocarbon
- 1.10 Inorganic (no carbon in polymer backbone; see 1.33 for silicone)
- 1.10A Ionomer
- 1.11 Phenolic
- 1.12 Phenyl-silane
- 1.12A Phenyl oxide, Phenylene oxide
- 1.13 Poly(amide)
- 1.14 Poly(carbonate)
- 1.15 Poly(ester); alkyd
- 1.16 Poly(ether)
- 1.17 Poly(ethylene)
- 1.17A Ethylene-copolymers
- 1.18 Poly(imide)
- 1.19 Poly(propylene)
- 1.20 Poly(styrene) group
- 1.21 Poly(sulfide)
- 1.22 Poly(urethane)
- 1.23-1.32 Semiorganic polymers (Carbon + element listed below in backbone)
- 1.23 Aluminum in backbone
- 1.24 Arsenic in backbone
- 1.25 Boron in backbone
- 1.26 Chromium in backbone
- 1.27 Nitrogen in backbone (excluding polyamide and polyurethane)
- 1.28 Phosphorus in backbone
- 1.29 Sulphur in backbone
- 1.30 Tin in backbone
- 1.31 Titanium in backbone
- 1.32 Other element in backbone
- 1.33 Silicone (see 1.12 for phenyl silane)
- 1.34 Vinyls
- 1.35 Unidentified

## 2. TABULATED OR GRAPHICAL DATA ON THESE PROPERTIES AND/OR UNDER THE ENVIRONMENT LISTED HEREIN

- 2.1 Acoustic
- 2.2 Adhesive
- 2.3 Aging (except 2.16, 2.23)
- 2.4 Effect of chemicals (except 2.5-2.12)
- 2.5 Compatibility
- 2.6 Effects of water or moisture
- 2.7 Molecular/polymer structure
- 2.8 Permeability, vapor transmission
- 2.10 Stress cracking, crazing
- 2.11 Toxicity
- 2.12 Weight loss
- 2.13-2.16 Electrical properties
- 2.13 Excepting 2.14 -2.16
- 2.14 Arc, corona, tracking, treeing
- 2.15 Electric strength
- 2.16 Thermal aging of elec comp
- 2.17-2.23 Properties under these environments
- 2.17 Environments except 2.18-2.23
- 2.18 Irradiation
- 2.19 Vacuum
- 2.20-2.23 Properties at these conditions
- 2.20 Prop. at temp below -100°F
- 2.21 Prop. at temp (-100°F to +32°F)
- 2.21A Prop. at temp (+150°F to 500°F)
- 2.22 Prop. at temp over 500°F
- 2.23 Weathering
- 2.24-2.36 Mechanical properties
- 2.24 Other than 2.25-2.36
- 2.25 Bearing
- 2.26 Cushioning; damping
- 2.27 Creep
- 2.28 Compression
- 2.29 Dynamic loading
- 2.30 Fatigue
- 2.31 At high load rate
- 2.32 Hoop tension; burst; buckling
- 2.33 Modulus; compliance
- 2.34 Shear
- 2.35 Stress relaxation
- 2.36 Stress-strain curve
- 2.37 Optical incl infra red spectra
- 2.38 Rheological
- 2.39 Surface
- 2.40-2.42 Thermal
- 2.41 Thermal other than 2.41-2.42
- 2.41 Ablation
- 2.42 Flammability
- 2.43 Thermodynamic

## Breakdown of Plastic Material Sub-groups in Code Sheet

Some materials listed under 1 in code sheet cover several groups - i. e. 1.11 Phenolic - covers Phenol-formaldehyde and Phenol-furfural. Following are the material subgroups used in this report.

1.2	Acrylic Polymethyl methacrylate Methyl methacrylate-styrene copolymer	1.23-1.32	Semiorganic polymer If a polymer containing two or more such elements is listed - i. e., polybenzborimidazolines, then it is listed in each group, i. e., 1.25, 1.27.
1.3	Allylic Diallyl phthalate Other diallyl materials	1.25	Boron in polymer backbone Polybenzborimidazolines Polyborophane
1.4	Amino Urea formaldehyde Melamine formaldehyde	1.27	Nitrogen in polymer backbone (Aliphatic polyamide, i. e. nylon and the urethanes are not listed in this group.) Polybenzimidazole Polybenzborimidazolines Polyoxadiazole Polyhydrazide Polyphenylene triazole Polythiazole
1.6	Cellulosic Ethyl cellulose Cellulose acetate Cellulose propionate Cellulose acetate butyrate Cellulose nitrate		
1.8	Epoxy Epoxy casting and molding materials Epoxy novolac Epoxy polyolefin Epoxidized polybutadiene Phenoxy	1.28    1.29	Phosphorus in polymer backbone Polyborophane  Sulphur in polymer backbone (excluding polysulfides) Polythiazole Polyphenylene sulfide Polytriazinylene sulfide
1.9	Fluorocarbon Polytetrafluoroethylene Fluorinated ethylene propylene polymers Polychlorotrifluoroethylene Polyvinylidene fluoride	1.34	Vinyls, vinyl chloride Vinyl acetate Vinyl alcohol Vinyl butyral Vinyl chloride Vinyl chloride-acetate Vinylidene chloride Vinyl formal Polyvinylidene dichloride
1.11	Phenolic Phenol-formaldehyde Phenol-furfural		
1.20	Polystyrene Group (see also 1.5) Polystyrene Styrene-acrylonitrile copolymer Acrylonitrile-butadiene-styrene terpolymers and blends		

Both the main group - i. e., Phenolic- and subgroup - i. e., Phenolformaldehyde and Phenol-furfural - are listed by their chemical nomenclature. In order to determine the chemical group of a particular commercial plastic material - i. e., Teflon, or the trade name of particular materials, it is suggested that the reader refer to the published lists of plastic material trade names. One source is the Modern Plastics Encyclopedia.\*

\* Modern Plastics Encyclopedia, published yearly.

## SECTION 9. BIBLIOGRAPHY

In this bibliography, the items are listed under the particular conference at which they were presented. When the conference was programmed as to specific interests, such sub-divisions have been retained and identified.

The reference numbers are of within-report interest only. These were assigned, progressively, across all conferences reported.

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March 1-4, 1965, Boston  
Society of Plastics Engineers, Inc.

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- 455 High and Low Temp. Adhesives - Where We Stand, by R. C. Kausen (A. D. Little Co.) 51 p. sec. 1 (1.1, 1.7, 1.8, 1.11, 1.12, 1.13, 1.18, 1.22, 1.25, 1.27, 1.28, 1.29, 1.32, 1.33, 1.34, 2.2, 2.3, 2.7, 2.20, 2.21A, 2.22, 2.34)
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